PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Assistant Commissioner for Patents
United States Patent and Trademark Office
Box PCT
Washington, D.C.20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 22 August 2000 (22.08.00)	
International application No. PCT/IL00/00010	**Applicant's or agent's file reference** 1219401.1 LK
International filing date (day/month/year) 06 January 2000 (06.01.00)	**Priority date** (day/month/year) 07 January 1999 (07.01.99)
Applicant REGEV, Reuven	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

19 July 2000 (19.07.00)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

Claudio Borton

Telephone No.: (41-22) 338.83.38

CLAIMS:

1. A scanner for scanning a surface characterized in that it has a one-dimensional optical sensor and has no mechanical moving parts for determining the scanning speed.

2. A method for processing an acquired text image obtained by scanning a text with a scanner, the text having one or more fonts, each font having a font ratio, each location in the text having been scanned at an instantaneous scanning speed, where the text image is distorted due variability of the instantaneous scanning speed, the method comprising the following steps:

(a) providing a mode character height for each font; and

(b) utilizing said mode character height and font ratio for constructing a correction factor in order to correct the distorted text image.

3. The method of Claim 2 for determining the instantaneous correction factor at one or more essentially vertical stacks in an acquired text image, the essentially vertical stacks having widths, wherein said step (b) further includes utilizing the widths of one or more essentially vertical stacks in the acquired text image.

4. A method according to Claim 3 comprising the steps of:

(a) determining the mode character height of the scanned text;

(b) calculating a reference line width by dividing the mode character height by the font ratio;

(c) determining the height and width of the one or more essentially vertical stacks;

(d) calculating an instantaneous correction factor for any one of the one or more essentially vertical stacks by dividing the reference width by the width of the essentially vertical stack to obtain the instantaneous correction factor at the essentially vertical stack; and

(e) setting the correction factor equal to one when the correction factor calculated according to step (d) is greater than one.

5. The method of Claim 4, further comprising the steps of:

(a) partitioning one or more stop segments into a predetermined number of subsegments of consecutive fields of view; and

(b) deleting from each subsegment at least one, but not all, of the fields of view in the subsegment.

6. The method of Claim 5 further comprising the step of calculating an instantaneous correction factor in one or more stop segments wherein the instantaneous correction factor in a stop segment is a predetermined value.

7. A method for calculating an instantaneous correction factor at a location in an acquired text image not comprising an essentially vertical stack and not comprising a a stop segment that has been corrected according to the method of Claim 6, wherein the method comprises either:

(a) identifying essentially vertical stacks flanking the location on different sides; calculating the instantaneous correction factor at each one of the two essentially vertical stacks by the method of Claim 3 or 4, and calculating the instantaneous correction factor at said location by interpolation of the instantaneous correction factors of the essentially vertical stacks;

(b) identifying a subsegment in each of two stop segments flanking the location on different sides, calculating the instantaneous correction factor at each one of the two subsegments by the method of Claim 6, and calculating the instantaneous correction factor at said location by interpolation of the instantaneous correction factors of the subsegments; or

(c) identifying an essentially vertical stack and a subsegment of a stop segment flanking the location on different sides, calculating the instantaneous correction factor at the essentially vertical stack by the method of Claim 3 or 4, calculating the instantaneous correction

factor at the subsegment by the method of Claim 6, and calculating the instantaneous correction factor at said location by interpolation of the instantaneous correction factors of the essentially vertical stack and the stop segment.

8. A method for removing distortions at one or more locations in an acquired text image due to variation in the scanning speed during scanning of a text, the method comprising the steps of:

(a) calculating the instantaneous correction factor at the one or more locations in the text image by the method of any one of Claims 2 to 7; and

(b) deleting fields of view at each of the one or more locations where the correction factor is less than one so as to produce a rescaling of the acquired text image at each location by a factor substantially equal to the instantaneous correction factor at each location.

9. The method of Claim 8 further comprising the step of processing the text image by character recognition software.

10. A scanner according to Claim 1 further comprising a CPU coupled to a storage medium and executing software for carrying out the method according to any one of Claims 2 to 9.

11. A storage medium storing an executable computer program for processing an acquired text image obtained by scanning a text with a scanner, the text having one or more fonts, each font having a font ratio, each location in the text having been scanned at an instantaneous scanning speed, where the text image is distorted due variability of the instantaneous scanning speed, the processing comprising the following steps:

(a) providing a mode character height for each font; and

(b) utilizing said mode character height and font ratio for constructing a correction factor in order to correct the distorted text image.

12. The storage medium of Claim 11storing an executable computer program for determining the instantaneous correction factor at one or more essentially

vertical stacks in an acquired text image, the essentially vertical stacks having widths, wherein said step (b) further includes utilizing the widths of one or more essentially vertical stacks in the acquired text image.

13. The storage medium according to Claim 12 wherein the processing comprises the steps of:

(a) determining the mode character height of the scanned text;

(b) calculating a reference line width by dividing the mode character height by the font ratio;

(c) determining the height and width of the one or more essentially vertical stacks;

(d) calculating an instantaneous correction factor for any one of the one or more essentially vertical stacks by dividing the reference width by the width of the essentially vertical stack to obtain the instantaneous correction factor at the essentially vertical stack.

14. The storage medium of Claim 13, wherein the processing further comprising the steps of:

(a) partitioning one or more stop segments into a predetermined number of subsegments of consecutive fields of view; and

(b) deleting from each subsegment at least one, but not all, of the fields of view in the subsegment.

15. The storage medium of Claim 14 wherein the processing further comprises calculating an instantaneous correction factor in one or more stop segments wherein the instantaneous correction factor for a stop segment is a predetermined value.

16. The storage medium of Claim 15 wherein the processing further comprises calculating an instantaneous correction factor at a location in an acquired text image not comprising an essentially vertical stack and not comprising a subsegment of a stop segment that has been corrected according to the method of Claim 6, wherein the processing comprises either:

(a) identifying essentially vertical stacks flanking the location on different sides; calculating the instantaneous correction factor at each one of the two essentially vertical stacks by the method of Claim 3 or 4, and calculating the instantaneous correction factor at said location by interpolation of the instantaneous correction factors of the essentially vertical stacks;

(b) identifying a subsegment in each of two stop segments flanking the location on different sides, calculating the instantaneous correction factor at each one of the two subsegments by the method of Claim 6, and calculating the instantaneous correction factor at said location by interpolation of the instantaneous correction factors of the subsegments; or

(c) identifying an essentially vertical stack and a subsegment of a stop segment flanking the location on different sides, calculating the instantaneous correction factor at the essentially vertical stack by the method of Claim 3 or 4, calculating the instantaneous correction factor at the subsegment by the method of Claim 6, and calculating the instantaneous correction factor at said location by interpolation of the instantaneous correction factors of the essentially vertical stack and the stop segment.

17. A storage medium storing an executable computer program for processing an acquired text image to remove distortions at one or more locations in the acquired text image due to variation in the scanning speed during scanning of a text, the processing comprising the steps of:

(a) calculating the instantaneous correction factor at the one or more locations in the text image by the method of any one of Claims 2 to 7; and

(b) deleting fields of view at each of the one or more locations where the correction factor is less than one so as to produce a rescaling of

the acquired text image at each location by a factor substantially equal to the instantaneous correction field at each location.

18. The storage medium of Claim 17 for processing the text image by character recognition software.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	**FOR FURTHER ACTION** see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
1219401.1 LK		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/IL 00/00010	06/01/2000	07/01/1999
Applicant		
TOPSCAN LTD. et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 2 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   [ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

   b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

   [ ] contained in the international application in written form.

   [ ] filed together with the international application in computer readable form.

   [ ] furnished subsequently to this Authority in written form.

   [ ] furnished subsequently to this Authority in computer readble form.

   [ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   [ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 5a, 5b

   [X] as suggested by the applicant.

   [ ] because the applicant failed to suggest a figure.

   [ ] because this figure better characterizes the invention.

   [ ] None of the figures.

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

REINHOLD COHN AND PARTNERS
P.O Box 4060
61040 Tel-Aviv
ISRAEL

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT
(PCT Rule 71.1)

Date of mailing *(day/month/year)*	06.04.2001

Applicant's or agent's file reference	IMPORTANT NOTIFICATION
1219401.1 LK	

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/IL00/00010	06/01/2000	07/01/1999

Applicant
TOPSCAN LTD. et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
1219401.1 LK		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/IL00/00010	06/01/2000	07/01/1999
International Patent Classification (IPC) or national classification and IPC G06K9/22		
Applicant TOPSCAN LTD. et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 6 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
19/07/2000	06.04.2001
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Herter, J Telephone No. +49 89 2399 7478

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/IL00/00010

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:
Description, pages:

1-11 as originally filed

Claims, No.:

1-17 with telefax of 17/12/2000

Drawings, sheets:

1/9-9/9 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☒ the claims, Nos.: 18

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-17
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-17
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-17
	No:	Claims	

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

1. Reference is made to the following documents:

   D1: EP-A-0 279 655 (Soricon Corp) 24 August 1988
   D2: EP-A-0 680 005 (IBM) 2 November 1995
   D3: US-A-5 581 633 (Hotta et al) 3 December 1996

2. **Item V: Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

   The present application meets the requirements of Articles 33(2) and 33(3) PCT because the subject matter of claims 1 and 10 is novel and involves and inventive step, the reasons being as follows:

   As to claim 1:
   D1 discloses:
   - A method for processing an acquired text image obtained by scanning a text with a scanner, the text having one or more fonts (see page 3, lines 6-7 and 12-13), each font having a font ratio (see page 3, line 13), each location in the text having been scanned at an instantaneous scanning speed (see page 3, lines 16-19), where the text image is distorted due variability of the instantaneous scanning speed (see page 2, lines 55-57), the method comprising the following steps:
   - (a) providing a mode character height for each font (see page 8, lines 36-39);

   D1 however does not disclose:
   - (b) utilizing said mode character height and font ratio for constructing a correction factor in order to correct the distorted text image.

   In D1, the instantaneous scanning speed is determined by comparing pixels of adjacent columns and this scanning speed is used to control the data transfer rate between the scanner and the input buffer of the character recognition software (see page 9, lines 18-34 and page 9, line 60 - page 10, line 10). D1 uses no font or character information for correcting the distorted image.

Document D2 discloses character normalization using font information in order to speed up subsequent character recognition and to make character recognition more stable (see abstract, left-hand column, line 1, - right-hand column, line 8). The method of D2 however does not account for characters which are distorted due to instantaneous scanning speed, but merely to character normalization. Font information is not used therein for constructing a correction factor in order to correct a distorted text image.

Document D3 discloses a method for segmenting hand-written text using histograms (see abstract, lines 1-9). D3 also does not use any font information for to correct a distorted text image.

An inventive step can thus be acknowledged.

As to claim 10:
Claim 10 is the corresponding storage medium claim to present method claim 1 and therefore also meets the requirements of Articles 33(2) and 33(3) PCT, applying the same reasoning as for claim 1 above.

3. **Item VII: Certain defects in the international application**

3.1 The independent claims are not in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would be appropriate, with those features known in combination from the prior art (document D1) being placed in the preamble (Rule 6.3(b)(i) PCT) and with the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).

3.2 The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

3.3 The description is not in conformity with the claims as required by Rule 5.1(a)(iii) PCT.

3.4 Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the document D1 is not mentioned in the description, nor is this document identified therein.

4. **Item VIII: Certain observations on the international application**

As to claims 1-7 and 10-16:
Claims 1-7 and 10-16 are not clear due to the terms "font ratio", "mode character height", "essentially vertical stack", "stop segments", "fields of view" used therein, since these terms do not have a common meaning and therefore are not known to the skilled person trying to determine the extent of protection sought.
An explanation for most of these terms (which can be found in the glossary on pages 2-4 of the description) should have been incorporated into the claims to remedy this clarity objection.

CLAIMS:

1. A method for processing an acquired text image obtained by scanning a text with a scanner, the text having one or more fonts, each font having a font ratio, each location in the text having been scanned at an instantaneous scanning speed, where the text image is distorted due variability of the instantaneous scanning speed, the method comprising the following steps:

(a) providing a mode character height for each font; and

(b) utilizing said mode character height and font ratio for constructing a correction factor in order to correct the distorted text image.

2. The method of Claim 1for determining the instantaneous correction factor at one or more essentially vertical stacks in an acquired text image, the essentially vertical stacks having widths, wherein said step (b) further includes utilizing the widths of one or more essentially vertical stacks in the acquired text image.

3. A method according to Claim 2 comprising the steps of:

(a) determining the mode character height of the scanned text;

(b) calculating a reference line width by dividing the mode character height by the font ratio;

(c) determining the height and width of the one or more essentially vertical stacks;

(d) calculating an instantaneous correction factor for any one of the one or more essentially vertical stacks by dividing the reference width by the width of the essentially vertical stack to obtain the instantaneous correction factor at the essentially vertical stack; and

(e) setting the correction factor equal to one when the correction factor calculated according to step (d) is greater than one.

4. The method of Claim 3, further comprising the steps of:

(a) partitioning one or more stop segments into a predetermined number of subsegments of consecutive fields of view; and

(b) deleting from each subsegment at least one, but not all, of the fields of view in the subsegment.

5. The method of Claim 4 further comprising the step of calculating an instantaneous correction factor in one or more stop segments wherein the instantaneous correction factor in a stop segment is a predetermined value.

6. A method for calculating an instantaneous correction factor at a location in an acquired text image not comprising an essentially vertical stack and not comprising a a stop segment that has been corrected according to the method of Claim 5, wherein the method comprises either:

(a) identifying essentially vertical stacks flanking the location on different sides; calculating the instantaneous correction factor at each one of the two essentially vertical stacks by the method of claim 2 or 3, and calculating the instantaneous correction factor at said location by interpolation of the instantaneous correction factors of the essentially vertical stacks;

(b) identifying a subsegment in each of two stop segments flanking the location on different sides, calculating the instantaneous correction factor at each one of the two subsegments by the method of Claim 5, and calculating the instantaneous correction factor at said location by interpolation of the instantaneous correction factors of the subsegments; or

(c) identifying an essentially vertical stack and a subsegment of a stop segment flanking the location on different sides, calculating the instantaneous correction factor at the essentially vertical stack by the method of Claim 2 or 3, calculating the instantaneous correction

factor at the subsegment by the method of Claim 5 and calculating the instantaneous correction factor at said location by interpolation of the instantaneous correction factors of the essentially vertical stack and the stop segment.

7. A method for removing distortions at one or more locations in an acquired text image due to variation in the scanning speed during scanning of a text, the method comprising the steps of:

(a) calculating the instantaneous correction factor at the one or more locations in the text image by the method of any one of Claims 1 to 6 and

(b) deleting fields of view at each of the one or more locations where the correction factor is less than one so as to produce a rescaling of the acquired text image at each location by a factor substantially equal to the instantaneous correction factor at each location.

8. The method of Claim 7 further comprising the step of processing the text image by character recognition software.

9. A system for processing a text comprising:

(a) a scanner having a one-dimensional optical sensor and no mechanical parts for determining scanning speed; and

(b) a CPU coupled to a storage medium and executing software for carrying out the method according to any one of Claims 1 to 8.

10. A storage medium storing an executable computer program for processing an acquired text image obtained by scanning a text with a scanner, the text having one or more fonts, each font having a font ratio, each location in the text having been scanned at an instantaneous scanning speed, where the text image is distorted due variability of the instantaneous scanning speed, the processing comprising the following steps:

(a) providing a mode character height for each font; and

(b) utilizing said mode character height and font ratio for constructing a correction factor in order to correct the distorted text image.

11. The storage medium of Claim 10 storing an executable computer program for determining the instantaneous correction factor at one or more essentially vertical stacks in an acquired text image, the essentially vertical stacks having widths, wherein said step (b) further includes utilizing the widths of one or more essentially vertical stacks in the acquired text image.

12. The storage medium according to Claim 11 wherein the processing comprises the steps of:

(a) determining the mode character height of the scanned text;

(b) calculating a reference line width by dividing the mode character height by the font ratio;

(c) determining the height and width of the one or more essentially vertical stacks;

(d) calculating an instantaneous correction factor for any one of the one or more essentially vertical stacks by dividing the reference width by the width of the essentially vertical stack to obtain the instantaneous correction factor at the essentially vertical stack.

13. The storage medium of Claim 12, wherein the processing further comprising the steps of:

(a) partitioning one or more stop segments into a predetermined number of subsegments of consecutive fields of view; and

(b) deleting from each subsegment at least one, but not all, of the fields of view in the subsegment.

14. The storage medium of Claim 13 wherein the processing further comprises calculating an instantaneous correction factor in one or more stop segments wherein the instantaneous correction factor for a stop segment is a predetermined value.

15. The storage medium of Claim 14 wherein the processing further comprises calculating an instantaneous correction factor at a location in an acquired text image not comprising an essentially vertical stack and not comprising a subsegment of a stop segment that has been corrected according to the method of Claim 5, wherein the processing comprises either:

(a) identifying essentially vertical stacks flanking the location on different sides; calculating the instantaneous correction factor at each one of the two essentially vertical stacks by the method of Claim 2 or 3, and calculating the instantaneous correction factor at said location by interpolation of the instantaneous correction factors of the essentially vertical stacks;

(b) identifying a subsegment in each of two stop segments flanking the location on different sides, calculating the instantaneous correction factor at each one of the two subsegments by the method of Claim 5, and calculating the instantaneous correction factor at said location by interpolation of the instantaneous correction factors of the subsegments; or

(c) identifying an essentially vertical stack and a subsegment of a stop segment flanking the location on different sides, calculating the instantaneous correction factor at the essentially vertical stack by the method of Claim 2 or 3, calculating the instantaneous correction factor at the subsegment by the method of Claim 6, and calculating the instantaneous correction factor at said location by interpolation of the instantaneous correction factors of the essentially vertical stack and the stop segment.

16. A storage medium storing an executable computer program for processing an acquired text image to remove distortions at one or more locations in the acquired text image due to variation in the scanning speed during scanning of a text, the processing comprising the steps of:

(a) calculating the instantaneous correction factor at the one or more locations in the text image by the method of any one of Claims 1 to 6; and

(b) deleting fields of view at each of the one or more locations where the correction factor is less than one so as to produce a rescaling of the acquired text image at each location by a factor substantially equal to the instantaneous correction field at each location.

17. The storage medium of Claim 16 for processing the text image by character recognition software.

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WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : G06K 9/22 — A1

(11) International Publication Number: WO 00/41128

(43) International Publication Date: 13 July 2000 (13.07.00)

(21) International Application Number: PCT/IL00/00010

(22) International Filing Date: 6 January 2000 (06.01.00)

(30) Priority Data:

127958	7 January 1999 (07.01.99)	IL
132719	3 November 1999 (03.11.99)	IL

(71) Applicant *(for all designated States except US)*: TOPSCAN LTD. [IL/IL]; Bialik Street 155, 52523 Ramat Gan (IL).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: REGEV, Reuven [IL/IL]; Anda Amir 4, 34992 Haifa (IL).

(74) Agent: REINHOLD COHN AND PARTNERS; P.O.Box 4060, 61040 Tel Aviv (IL).

(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

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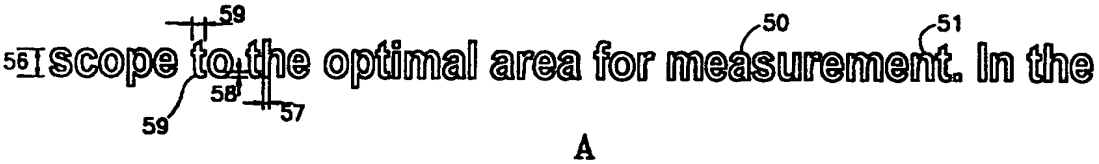

A

B

(57) Abstract

The invention provides a scanner for scanning a surface having a one–dimensional optical sensor and no mechanical moving parts for determining the scanning speed. A method is also provided for processing a text image obtained by scanning a text with a scanner, where the text image is distorted due to variability of the instantaneous scanning speed. The method utilizes the mode character height and font ratio for each font in the text obtaining a local correction factor at each location in the text image. The correction factor is related to the instantaneous scanning speed at the location and is used to correct the distorted text image.

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OPTICAL SCANNER AND SOFTWARE THEREFOR

FIELD OF THE INVENTION

The present invention is in the field of text scanners and software for use therewith.

BACKGROUND OF THE INVENTION

Hand-held optical scanners are used in a variety of applications including text scanning, barcode reading, and picture grabbing. These scanners comprise an optical sensor for acquiring image information that is managed by a central processing unit (CPU) and stored in a memory. The information is typically processed by character recognition software and then sent to a user application such as a word processor, database or spreadsheet.

The viewing area of hand-held scanners at a given instant includes only a small portion of the entire scanned medium. Thus in use, a hand-held scanner is made to pass over the entire scanned medium so as to produce a time series of acquired images where each acquired image corresponds to a small portion of the scanned medium. Since the images are acquired at a constant rate, subsequent reconstruction of the scanned medium from the series of acquired images produces a distorted image due to variation in the scanning speed during scanning. A hand held scanner has a reference scanning speed at which the acquired image is identical to the original. The reference scanning speed is the product of the width (in the scanning direction) of the optical sensor and the rate at which images are acquired by the sensor. Locations in the scanned medium acquired when the scanning speed is below the reference speed appear to be stretched or expanded, while locations acquired when the scanning speed is above the reference speed

appear compressed. Such distorted images may not be recognizable by character recognition software. Each acquired image must thus be processed by rescaling it in the scanning direction by a correction factor equal to the instantaneous scanning speed divided by the reference speed. Prior art scanners therefore comprise means for continuously monitoring the instantaneous scanning speed. U.S. Patent 5,083,218, for example, discloses a hand-held scanner comprising a wheel that rolls along the scanned medium during scanning for measuring the instantaneous speed at every moment during the scanning. U.S. Patent 5,023,922 discloses a hand-held scanner with a 2-dimensional optical sensor in which the instantaneous speed is calculated from the time interval required for an image to traverse the sensor. The presence of a wheel or a two dimensional sensor makes the hand held scanner bulky and awkward to use.

There is therefore a need in the art to provide a scanner that substantially reduces or overcomes the disadvantages of prior art scanners.

GLOSSARY

There follows a glossary of terms used in the following description and set of claims together with their definitions, some of them known in the art, others having been coined.

Field of view – the portion of the scanned medium acquired by a scanner at one instant.

Scanned image – a two-dimensional image created by moving a scanner over a surface. The scanned image is compiled from the time series of fields of view acquired during scanning.

Text image – A scanned image composed of text in any language.

Cluster – A contiguous group of black pixels in a text image. A black cluster is typically a single character but may be a portion of a single character, or a union of two or more characters.

Horizontal segment – A line of contiguous black pixels parallel to the text line, one pixel high. The length of a horizontal segment is the number of its black pixels.

Stack – A contiguous array of at least a predetermined number of horizontal segments in a scanned image with the following properties:

(a) No two of the horizontal segments are collinear.

(b) The ratio of the length of the longest horizontal segment in the stack to that of the shortest horizontal segment does not exceed a predetermined value.

(c) adjacent horizontal segments in the stack at least partially overlap (i. e. in a given pair of adjacent horizontal segments in the stack, there is at least one black pixel in each of the two horizontal segments acquired from the same field of view).

Each stack has associated with it a height that may be defined, for example, as the number of its composite horizontal segments. Each stack also has associated with it a width that may be defined, for example, as the average length of its horizontal composite segments, the minimal length of its horizontal composite segments, or the length of an arbitrary one of its horizontal segments. The invention is not to be considered as being bound by these definitions, and other definitions of height and width are contemplated within the scope of the invention. Each stack also has associated with it a bounding rectangle of minimum dimensions in which two opposite sides are vertical and two opposite sides are horizontal.

Essentially vertical stack - A stack whose height exceeds a predetermined number in which the ratio of the width of the stack to the width of its bounding rectangle exceeds a predetermined value.

Character recognition software - Any software package for converting a text image into a string of ASCII characters, for example Optical Character Recognition (OCR) software.

Stop interval – A series of consecutive fields of view, the number of which exceed a predetermined number, all of which are nearly identical to the first field of view. Two fields of view are considered to be nearly identical if there does not exist in one of the fields of view a subfield of contiguous pixels of length greater than a predetermined length in which all of the pixels are different from the corresponding pixels in the other field of view.

Font ratio – the ratio of the mode character height (the most common character height) to the most common essentially vertical line width of the characters in a particular font. The font ratio is a characteristic constant of a given font. For most fonts, the font ratio is typically, although not necessarily, around 6.

Correction factor - the instantaneous scanning speed divided by the reference speed.

SUMMARY OF THE INVENTION

In the following description and set of claims, the direction of the text line as well as the scanning direction of a hand held scanner is arbitrarily designated as the horizontal direction. This designation is being made only for the sake of simplicity in describing the invention. Other scanning directions are also contemplated within the scope of the invention and the invention is not to be considered as being bound by this arbitrary designation.

In its first aspect, the present invention provides a scanner having a one-dimensional (linear) optical sensor that creates an image one pixel wide and n pixels in length (height), and not having mechanical moving parts such as a

wheel. A series of scanned images is acquired at a constant rate determined by an internal clock inside the scanner when the scanner's sensor array is moved over a surface so as to scan a line of symbols. Image information obtained by the sensor may be stored and processed in a computer processing unit.

In its second aspect the present invention provides a method for determining the instantaneous correction factor of a text image during scanning by a hand held scanner. Since the instantaneous correction factor is equal to the instantaneous scanning speed divided by the reference speed of the scanner, the method is equivalent to a method for determining the instantaneous scanning speed. The method may be used with a scanner not having any mechanical moving parts. It may also be used with scanners having only a one-dimensional optical sensor. The method of the invention may be used for removing distortions in a text image due to variation in the scanning speed in order to make the text recognizable by optical character recognition software or readable as an image by a user

The method of the invention is based upon the observation that in a scanned image, vertical distances (i.e. distances perpendicular to the scanning direction) at any particular location are independent of the instantaneous scanning speed at that location. In particular, in a text image, the height of a text character is independent of the scanning speed. The mode character height in a text image is therefore independent of any variability in the scanning speed during acquisition of the text image. As disclosed below, the instantaneous scanning velocity, or equivalently the instantaneous correction factor, at a location in a text image comprising an essentially vertical stack can be determined from the width of the essentially vertical stack, the mode character height of the scanned text, and the font ratio.

The invention thus provides a scanner for scanning a surface characterized in that it has a one-dimensional optical sensor and has no mechanical moving parts for determining the scanning speed.

The invention also provides a method for processing an acquired text image obtained by scanning a text with a scanner, the text having one or more fonts, each font having a font ratio, each location in the text having been scanned at an instantaneous scanning speed, where the text image is distorted due variability of the instantaneous scanning speed, the method comprising the following steps:

(a) Providing a mode character height for each font; and

(b) utilizing said mode character height and font ratio for constructing a correction factor in order to correct the distorted text image.

The invention further provides a storage medium storing an executable computer program for processing an acquired text image obtained by scanning a text with a scanner, the text having one or more fonts, each font having a font ratio, each location in the text having been scanned at an instantaneous scanning speed, where the text image is distorted due variability of the instantaneous scanning speed, the processing comprising the following steps:

(a) Providing a mode character height for each font; and

(b) utilizing said mode character height and font ratio for constructing a correction factor in order to correct the distorted text image.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to understand the invention and to see how it may be carried out in practice, a preferred embodiment will now be described, by way of non-limiting example only, with reference to the accompanying drawings, in which:

Fig. 1 shows a hand-held scanner according to the invention;

Fig. 2 shows a block diagram of the processing carried out according to the invention;

Fig. 3 shows 7 characters resolved into 8 clusters;

Fig. 4, a and **b** each show a cluster decomposed into horizontal segments;

Fig. 5a shows a line of text to be scanned;

Fig. 5b shows a text image obtained by scanning the line of text of Fig. 5a with a hand-held scanner;

Fig. 6 shows a flow chart for determining the instantaneous scanning speed according to the invention;

Fig. 7 a-c show parts of an acquired text image; and

Fig. 8 shows the acquired text image of Fig. 7 after correction in accordance with the invention.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

In its first aspect, the present invention provides a scanner having a one-dimensional optical sensor and not having mechanical moving parts such as a wheel. As shown in Fig. 1, the scanner, generally designated as **1**, has a one-dimensional optical sensor **2**, a handle **3** for grasping, and no mechanical moving parts. A series of scanned images is acquired by moving the sensor **2** over a surface. Fig. 2 is a block diagram of a system comprising a one-dimensional scanner and a processor according to the invention. The sensor **2** is used to scan a line of symbols. The sensor is linked to the input port of central processing unit **12**. The input function is managed by a CPU **14**. Image information **16** obtained by sensor **10** may be stored by the CPU in a memory **18**. The structure of the system of the invention is not bound to the specific architecture depicted in Fig. 2.

In its second aspect the present invention provides a method for determining the instantaneous correction factor of a text image during scanning by a hand held scanner. The method may be used with a scanner not having any mechanical moving parts. It may also be used with scanners having only a one-dimensional optical sensor. The method of the invention may be used for removing distortions due to variation in the scanning speed in the text image 16 acquired by the sensor 2

in order to make the text recognizable by character recognition software or by a user. The method, to be described below in detail, is carried out by an application **20** that processes the image either in real time or off-line in respect of image *a priori* stored in memory **18**. The results of the processing may optionally be processed by character recognition software before being returned to the CPU or sent to interface **22**.

Referring now to Fig. 3, 7 characters are shown resolved into eight clusters. Clusters 31, 35 and 38 each form an entire character (e, c and e, respectively). Cluster 32 is a union of two characters (ff). Clusters 33, 34, 36 and 37 each contain a part of a character (i).

Fig. 4 shows two clusters divided into composite pixels. In Fig. 4a, horizontal line **49**, for example, has a length of 6 (pixels), and horizontal line **40** has a length of 8. Stack **42** has a height of 12. If horizontal line **40** were to be added to stack **42**, the resulting composite structure would not be a stack because the ratio of the length of the longest horizontal segment (8) to that of the shortest horizontal segment (5) in the structure would exceed a typical predetermined value of 1.3. Two of the twelve horizontal lines constituting stack **42** designated as **45a** and **45b** have a length of 5, while the other ten have a length of 6. The width of stack **42** (the average length of its horizontal lines) is thus calculated to be 5.83. In Fig. 4b stack **43** has a height of 6 and a width of 28, which is equal to the cluster width. Stack 43 is not considered to be an essentially vertical stack because its height does not exceed a typical predetermined value of about 8. Stack **44** is composed of 13 horizontal line segments of lengths of 5-6. In this stack, there is no overlap between the lowest **46** and highest **47** horizontal line segments. Stack **44** is also not an essentially vertical stack because the ratio of its width (6.3) to the width of its bounding rectangle **48** (12) does not exceed a typical predetermined value of about 0.75. The above mentioned predetermined values used in reference to the clusters of Fig. 4, are by way of example only, and the invention is not bound by these predetermined values.

Fig. 5a shows a line of text to be scanned. Arrows **56** indicate the mode character height, and arrows **57** show the most common vertical line width. In some fonts, essentially vertical lines are slightly slanted from a true vertical position. The ratio of the mode character height **56** to the most common essentially vertical line width **57** (the font ratio) is a characteristic constant of the font.

Fig. 5b shows a typical text image obtained by scanning the text line in Fig. 5a with a hand-held scanner. The text appears distorted due to variation in the scanning speed. Character widths are inversely proportional to the scanning speed. As can be seen by comparing the width of characters **50** and **51** in the original text (Fig. 5a) with their images in the text scan (Fig 5b), in interval **54** the instantaneous scanning speed was greater than the reference speed of the scanner, while in interval **55** the instantaneous scanning speed was below the reference speed. Vertical line widths, for example that of vertical line **59**, are also inversely proportional to the scanning speed. The mode character height **56**, however, is unaffected by the variability in the scanning speed and is the same in Figs. 5a and 5b. Horizontal line widths, for example that of line **58**, are also unaffected by variations in scanning speed. Interval **52** is a typical stop segment.

Fig. 6 shows a flow chart describing the method in accordance with one embodiment of the invention for determining the instantaneous correction factor at different locations in an acquired text image such as the one shown in Fig. 7. The font ratio for the font of the text from which the acquired text image shown in Fig. 7 was obtained is, by this example, about 6. The mode height of the text characters is determined **60**, which, as stated above, is independent of any variability in the scanning speed. The mode character height of the acquired text shown in Fig. 7 is indicated by double arrow **70** and is equal, by this example, to 26 pixels. A reference width is calculated **61** which is equal to the mode character height divided by the font ratio. For the text image of Fig. 7, the reference width is thus calculated to be 26/6, or 4.3 pixels. Since the font ratio is defined as the ratio of the mode character height to the most common essentially

vertical line width of the characters comprising the font , the reference width is the expected width of an essentially vertical stack when the scanning speed is equal to the reference speed. All essentially vertical stacks in the text image are then identified **63**. Numerals **71-91** indicate all of the 21 essentially vertical stacks in Fig. 7. The widths of the essentially vertical stacks are determined **64**. Essentially vertical stacks having a width greater than the reference width are those where the instantaneous scanning speed was below the reference speed of the scanner. Essentially vertical stacks having a width less than the reference speed are those where the instantaneous scanning speed was above the reference speed of the scanner. The correction factor at an image comprising an essentially vertical stack acquired when the scanning speed was below the reference speed is then obtained **65** by dividing the reference width by the width of the essentially vertical stack. For example, for essentially vertical stack **86**, whose width is greater than the reference width, the correction factor is thus calculated to be 4.3/5.5, or 0.8. The correction factor at an image comprising an essentially vertical stack acquired when the scanning speed was above the reference speed is 1.

The invention also provides for determining the correction factor at a stop segment in an acquired text image. A stop segment **102** is seen in Fig. 7. In stop segment **102**, all of the fields of view are nearly identical to the first field of view in the segment, which is indicative of a location in the acquired text image where the scanning speed was close to 0. Stop segment **102** is divided into a predetermined number of contiguous subsegments **66**. In Fig.7, stop segment **102** was divided into 4 subsegments. In each subsegment, at least one, but not all, of the consecutive fields of views is then deleted from the subsegment **67**. For example, if all of the fields of view are deleted from each subsegment except for one, then stop segment **102** would appear as segment **802** in Fig. 8. The correction factor in a stop segment is a predetermined value, for example, 0.1, which indicates that the instantaneous scanning speed in the stop segment was very slow.

Reverting to Fig. 6, the correction factor at a location not comprising an essentially vertical stack and not comprising a stop segment that has been processed as above, is determined by one of the following methods **68**. (i) Two essentially vertical stacks are found flanking the location on different sides. The correction factor is then determined at the location between the two essentially vertical stacks by interpolation of the correction factors at the two flanking essentially vertical stacks. (ii) Two stop segments are found flanking the location on different sides. The correction factor is then determined at the location between the two stop segments by interpolation of the correction factors at the two flanking stop segments. (iii) A stop segment and an essentially vertical stack are found flanking the location on different sides. The correction factor is then determined at the location between the stop segment and the essentially vertical stack by interpolation of the correction factors at the stop segment and the essentially vertical stack.

Once the correction factors during scanning of the text have been determined, the text image is rectified for distortions arising from variation in the scanning speed **69**. This is accomplished by deleting fields of view at each location where the correction factor is less than one so as to achieve a rescaling equal to the correction factor, as is known *per se*. When an essentially vertical stack is rectified in this way, it resembles the essentially vertical line in the text image which it represents in the scanned image. Fig. 8 shows the acquired text image shown in Fig. 7 after having been corrected.

While the invention has been described with a certain degree of particularity, it will be immediately apparent to those versed in the art that the method may be varied without departing from the scope of the invention. In particular, the order in which the steps of the method may be carried out may be changed without departing from the scope of the invention as defined in the following claims.

CLAIMS:

1. A scanner for scanning a surface characterized in that it has a one-dimensional optical sensor and has no mechanical moving parts for determining the scanning speed.

2. A method for processing an acquired text image obtained by scanning a text with a scanner, the text having one or more fonts, each font having a font ratio, each location in the text having been scanned at an instantaneous scanning speed, where the text image is distorted due variability of the instantaneous scanning speed, the method comprising the following steps:

(a) providing a mode character height for each font; and

(b) utilizing said mode character height and font ratio for constructing a correction factor in order to correct the distorted text image.

3. The method of Claim 2 for determining the instantaneous correction factor at one or more essentially vertical stacks in an acquired text image, the essentially vertical stacks having widths, wherein said step (b) further includes utilizing the widths of one or more essentially vertical stacks in the acquired text image.

4. A method according to Claim 3 comprising the steps of:

(a) determining the mode character height of the scanned text;

(b) calculating a reference line width by dividing the mode character height by the font ratio;

(c) determining the height and width of the one or more essentially vertical stacks;

(d) calculating an instantaneous correction factor for any one of the one or more essentially vertical stacks by dividing the reference width by the width of the essentially vertical stack to obtain the instantaneous correction factor at the essentially vertical stack; and

(e) setting the correction factor equal to one when the correction factor calculated according to step (d) is greater than one.

5. The method of Claim 4, further comprising the steps of:

(a) partitioning one or more stop segments into a predetermined number of subsegments of consecutive fields of view; and

(b) deleting from each subsegment at least one, but not all, of the fields of view in the subsegment.

6. The method of Claim 5 further comprising the step of calculating an instantaneous correction factor in one or more stop segments wherein the instantaneous correction factor in a stop segment is a predetermined value.

7. A method for calculating an instantaneous correction factor at a location in an acquired text image not comprising an essentially vertical stack and not comprising a a stop segment that has been corrected according to the method of Claim 6, wherein the method comprises either:

(a) identifying essentially vertical stacks flanking the location on different sides; calculating the instantaneous correction factor at each one of the two essentially vertical stacks by the method of Claim 3 or 4, and calculating the instantaneous correction factor at said location by interpolation of the instantaneous correction factors of the essentially vertical stacks;

(b) identifying a subsegment in each of two stop segments flanking the location on different sides, calculating the instantaneous correction factor at each one of the two subsegments by the method of Claim 6, and calculating the instantaneous correction factor at said location by interpolation of the instantaneous correction factors of the subsegments; or

(c) identifying an essentially vertical stack and a subsegment of a stop segment flanking the location on different sides, calculating the instantaneous correction factor at the essentially vertical stack by the method of Claim 3 or 4, calculating the instantaneous correction

factor at the subsegment by the method of Claim 6, and calculating the instantaneous correction factor at said location by interpolation of the instantaneous correction factors of the essentially vertical stack and the stop segment.

8. A method for removing distortions at one or more locations in an acquired text image due to variation in the scanning speed during scanning of a text, the method comprising the steps of:

(a) calculating the instantaneous correction factor at the one or more locations in the text image by the method of any one of Claims 2 to 7; and

(b) deleting fields of view at each of the one or more locations where the correction factor is less than one so as to produce a rescaling of the acquired text image at each location by a factor substantially equal to the instantaneous correction factor at each location.

9. The method of Claim 8 further comprising the step of processing the text image by character recognition software.

10. A scanner according to Claim 1 further comprising a CPU coupled to a storage medium and executing software for carrying out the method according to any one of Claims 2 to 9.

11. A storage medium storing an executable computer program for processing an acquired text image obtained by scanning a text with a scanner, the text having one or more fonts, each font having a font ratio, each location in the text having been scanned at an instantaneous scanning speed, where the text image is distorted due variability of the instantaneous scanning speed, the processing comprising the following steps:

(a) providing a mode character height for each font; and

(b) utilizing said mode character height and font ratio for constructing a correction factor in order to correct the distorted text image.

12. The storage medium of Claim 11storing an executable computer program for determining the instantaneous correction factor at one or more essentially

vertical stacks in an acquired text image, the essentially vertical stacks having widths, wherein said step (b) further includes utilizing the widths of one or more essentially vertical stacks in the acquired text image.

13. The storage medium according to Claim 12 wherein the processing comprises the steps of:

(a) determining the mode character height of the scanned text;

(b) calculating a reference line width by dividing the mode character height by the font ratio;

(c) determining the height and width of the one or more essentially vertical stacks;

(d) calculating an instantaneous correction factor for any one of the one or more essentially vertical stacks by dividing the reference width by the width of the essentially vertical stack to obtain the instantaneous correction factor at the essentially vertical stack.

14. The storage medium of Claim 13, wherein the processing further comprising the steps of:

(a) partitioning one or more stop segments into a predetermined number of subsegments of consecutive fields of view; and

(b) deleting from each subsegment at least one, but not all, of the fields of view in the subsegment.

15. The storage medium of Claim 14 wherein the processing further comprises calculating an instantaneous correction factor in one or more stop segments wherein the instantaneous correction factor for a stop segment is a predetermined value.

16. The storage medium of Claim 15 wherein the processing further comprises calculating an instantaneous correction factor at a location in an acquired text image not comprising an essentially vertical stack and not comprising a subsegment of a stop segment that has been corrected according to the method of Claim 6, wherein the processing comprises either:

(a) identifying essentially vertical stacks flanking the location on different sides; calculating the instantaneous correction factor at each one of the two essentially vertical stacks by the method of Claim 3 or 4, and calculating the instantaneous correction factor at said location by interpolation of the instantaneous correction factors of the essentially vertical stacks;

(b) identifying a subsegment in each of two stop segments flanking the location on different sides, calculating the instantaneous correction factor at each one of the two subsegments by the method of Claim 6, and calculating the instantaneous correction factor at said location by interpolation of the instantaneous correction factors of the subsegments; or

(c) identifying an essentially vertical stack and a subsegment of a stop segment flanking the location on different sides, calculating the instantaneous correction factor at the essentially vertical stack by the method of Claim 3 or 4, calculating the instantaneous correction factor at the subsegment by the method of Claim 6, and calculating the instantaneous correction factor at said location by interpolation of the instantaneous correction factors of the essentially vertical stack and the stop segment.

17. A storage medium storing an executable computer program for processing an acquired text image to remove distortions at one or more locations in the acquired text image due to variation in the scanning speed during scanning of a text, the processing comprising the steps of:

(a) calculating the instantaneous correction factor at the one or more locations in the text image by the method of any one of Claims 2 to 7; and

(b) deleting fields of view at each of the one or more locations where the correction factor is less than one so as to produce a rescaling of

the acquired text image at each location by a factor substantially equal to the instantaneous correction field at each location.

18. The storage medium of Claim 17 for processing the text image by character recognition software.

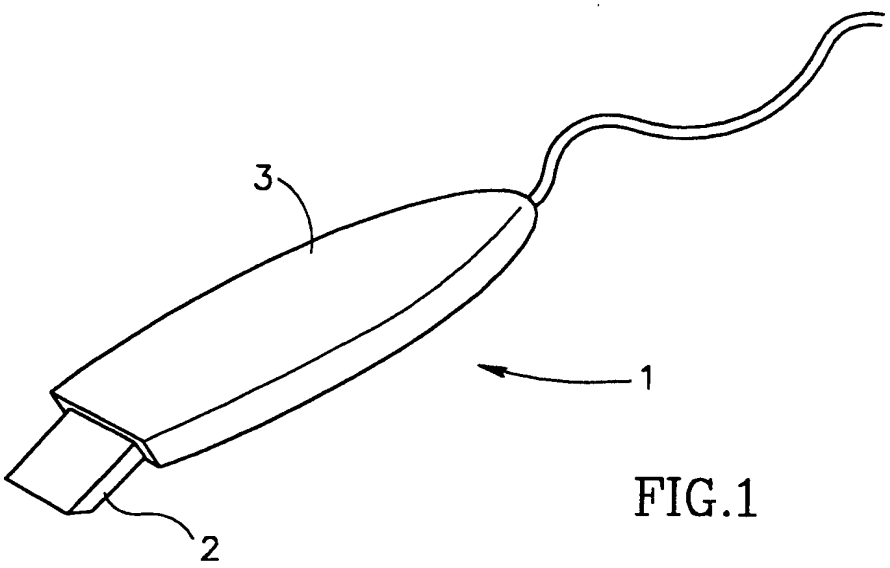
3
1
2

FIG.1

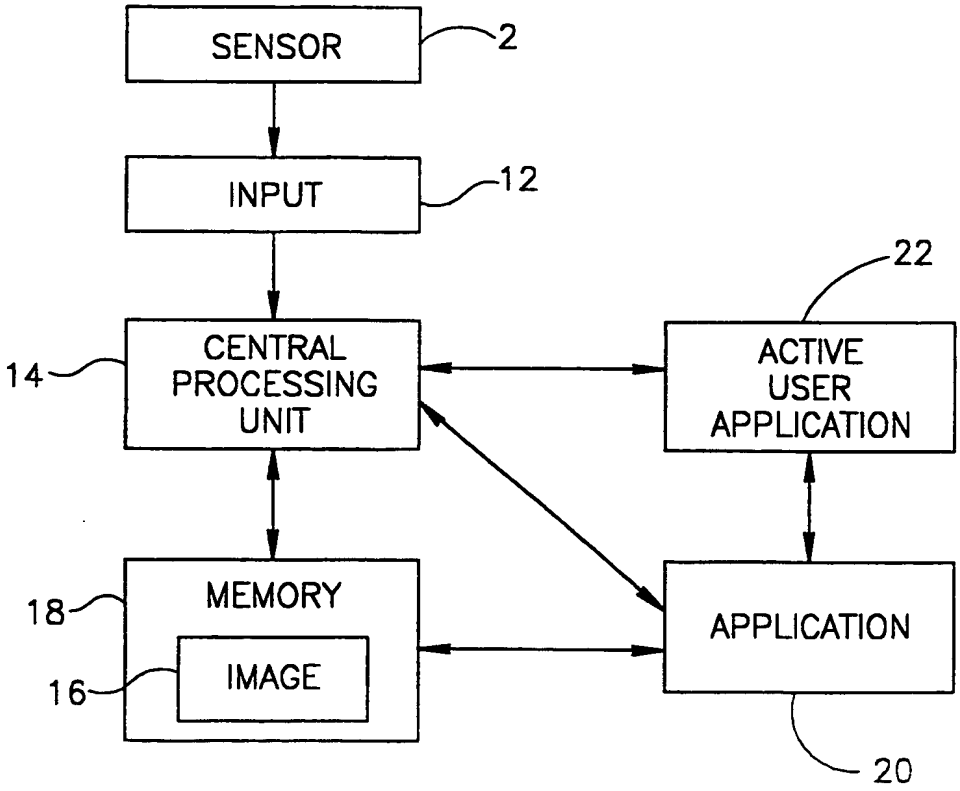
SENSOR
2
INPUT
12
22
14
CENTRAL PROCESSING UNIT
ACTIVE USER APPLICATION
MEMORY
18
IMAGE
16
APPLICATION
20

FIG.2

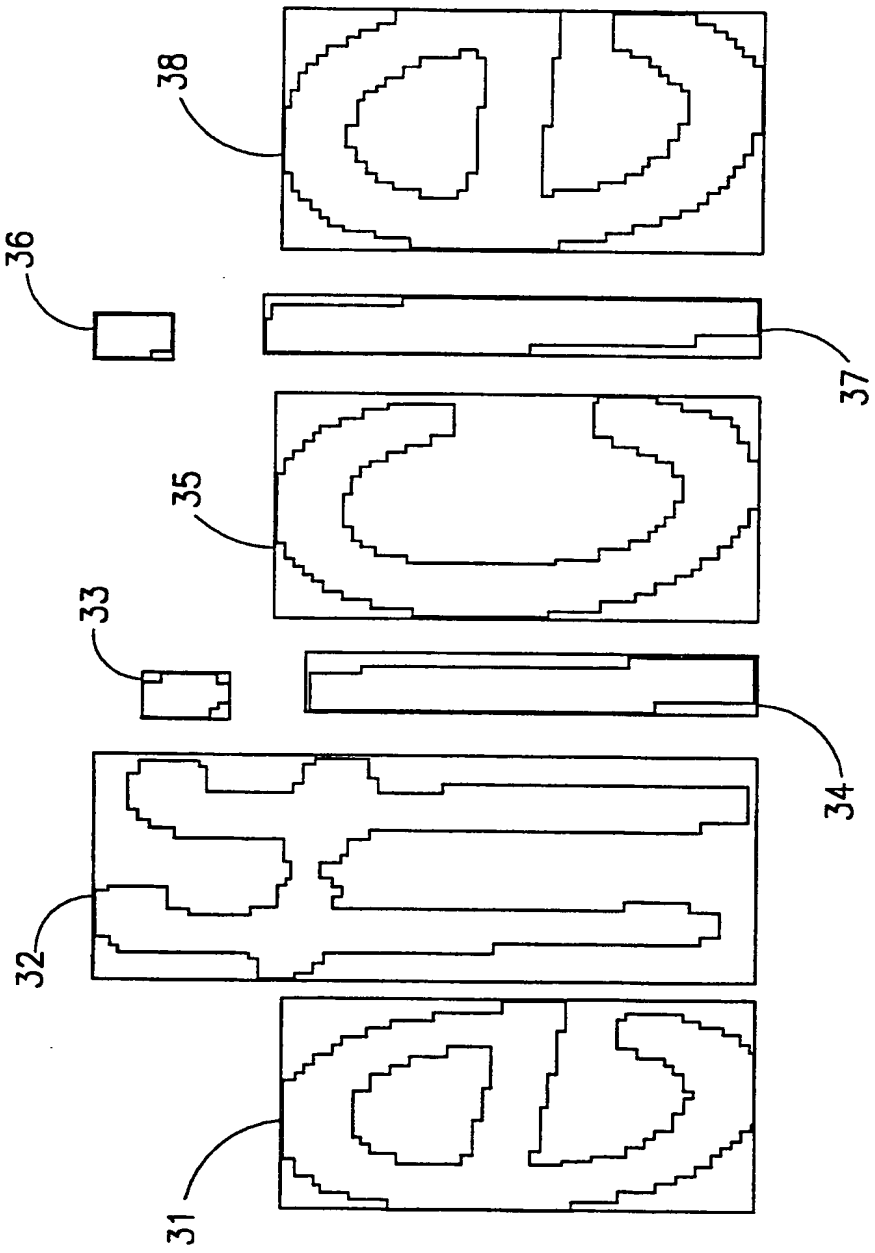

FIG.3

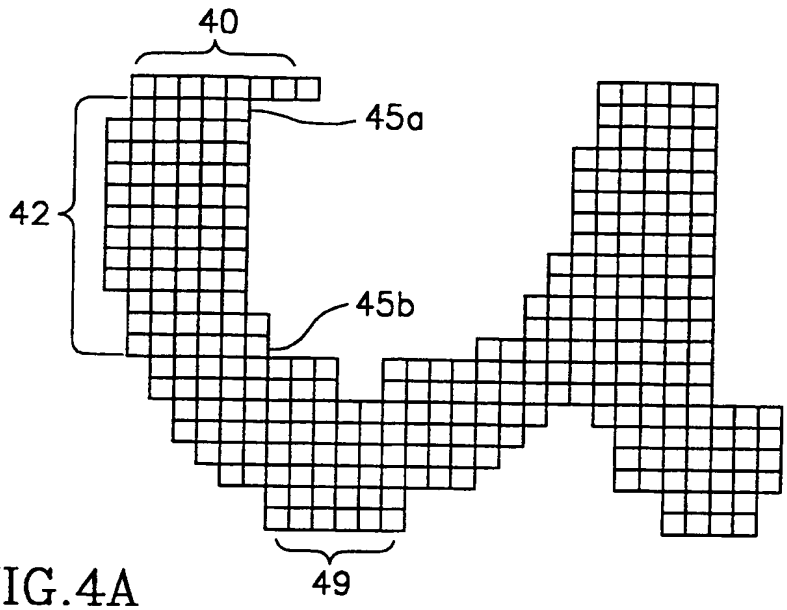

FIG.4A

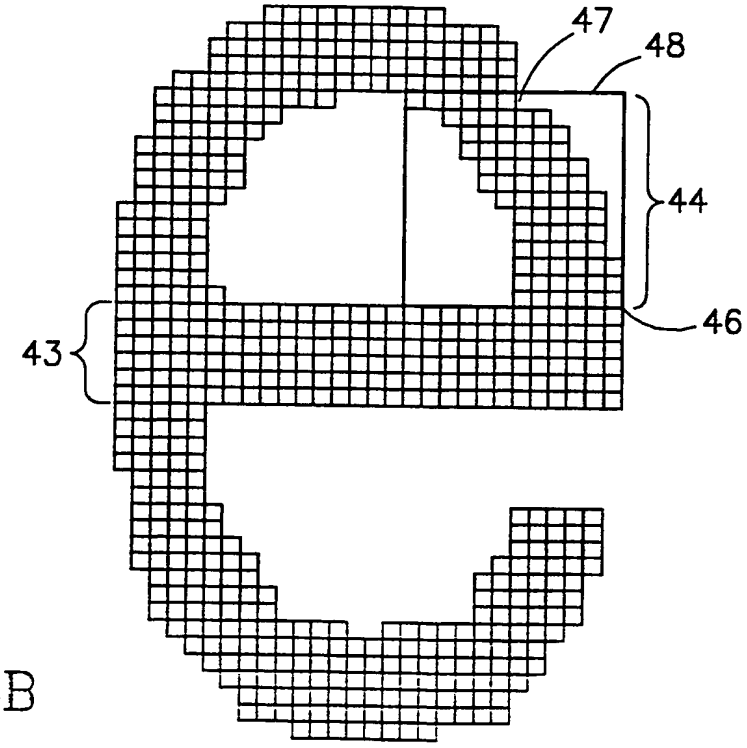

FIG.4B

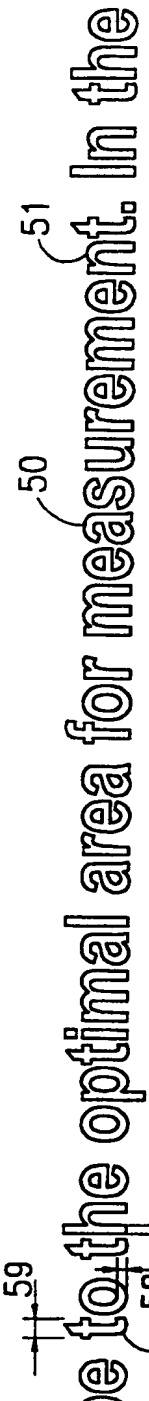
51
50
56 I scope to the optimal area for measurement. In the
59
58
57
59

FIG.5A

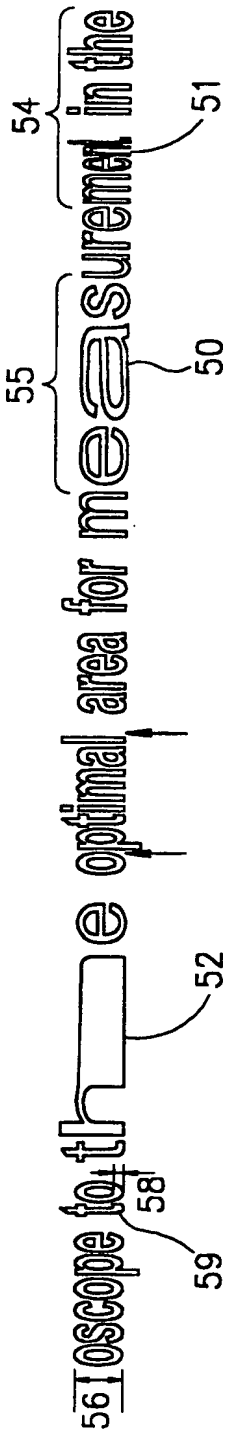
54
55
51
50
56 I scope to the optimal area for measurement in the
52
58
59

FIG.5B

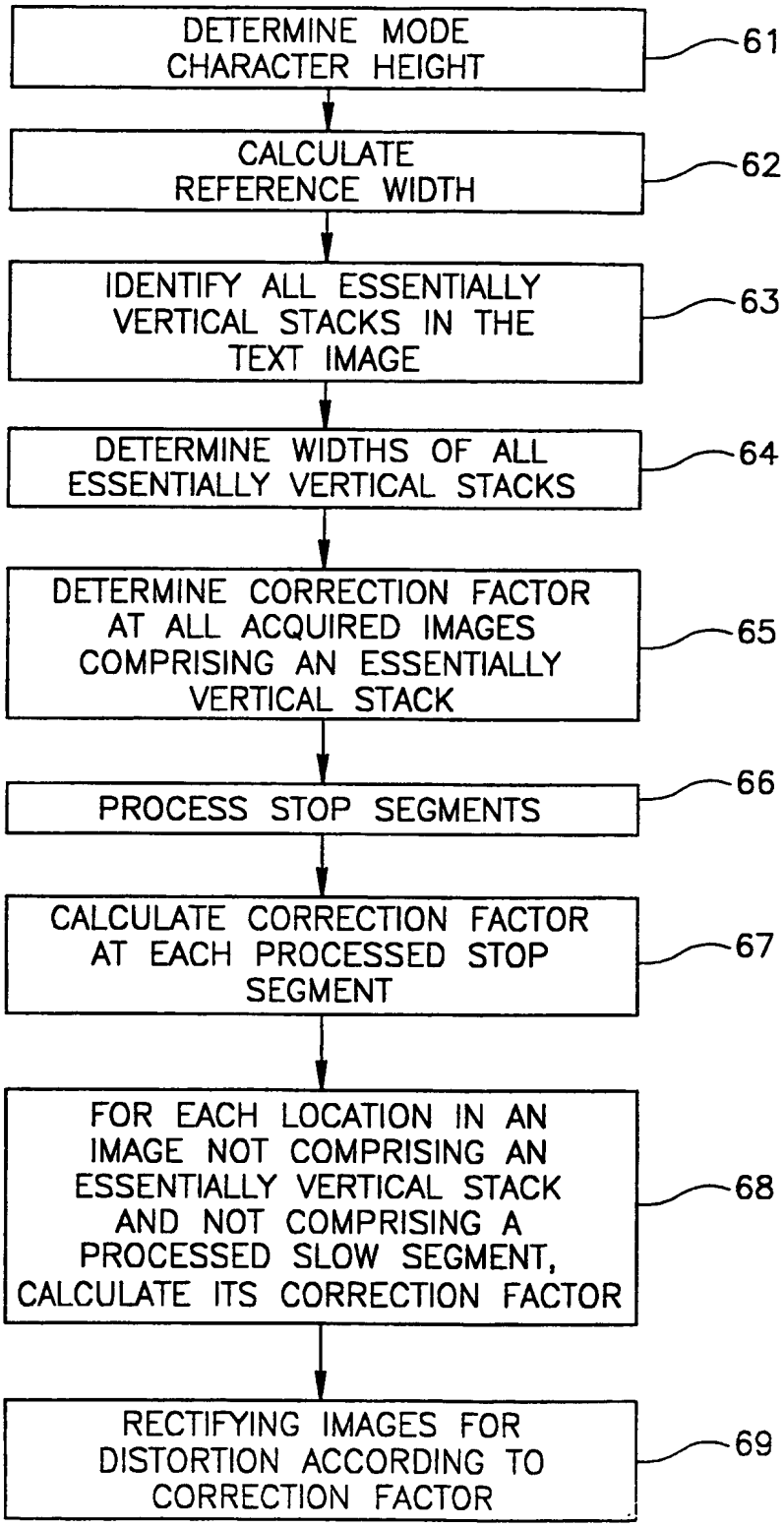
DETERMINE MODE CHARACTER HEIGHT
61
CALCULATE REFERENCE WIDTH
62
IDENTIFY ALL ESSENTIALLY VERTICAL STACKS IN THE TEXT IMAGE
63
DETERMINE WIDTHS OF ALL ESSENTIALLY VERTICAL STACKS
64
DETERMINE CORRECTION FACTOR AT ALL ACQUIRED IMAGES COMPRISING AN ESSENTIALLY VERTICAL STACK
65
PROCESS STOP SEGMENTS
66
CALCULATE CORRECTION FACTOR AT EACH PROCESSED STOP SEGMENT
67
FOR EACH LOCATION IN AN IMAGE NOT COMPRISING AN ESSENTIALLY VERTICAL STACK AND NOT COMPRISING A PROCESSED SLOW SEGMENT, CALCULATE ITS CORRECTION FACTOR
68
RECTIFYING IMAGES FOR DISTORTION ACCORDING TO CORRECTION FACTOR
69

FIG.6

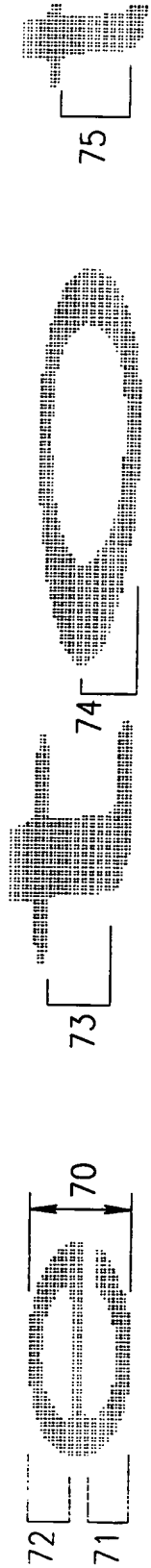

FIG.7A
BEGINNING

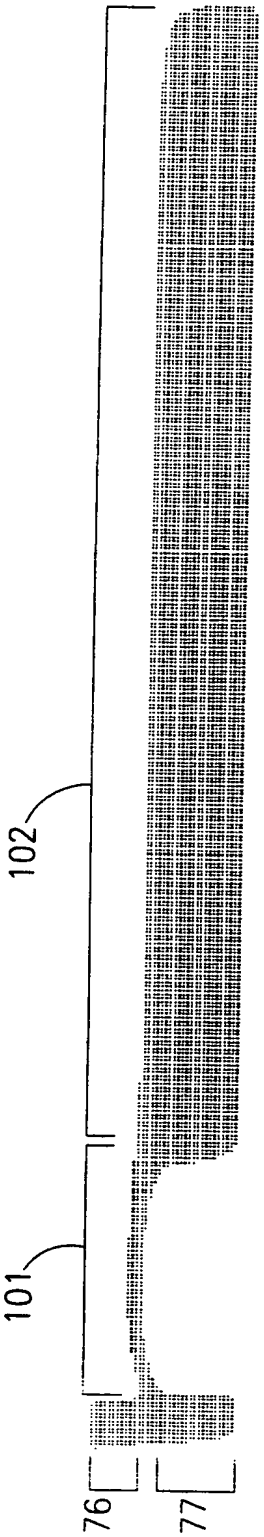

FIG. 7B
FIRST CONTINUATION

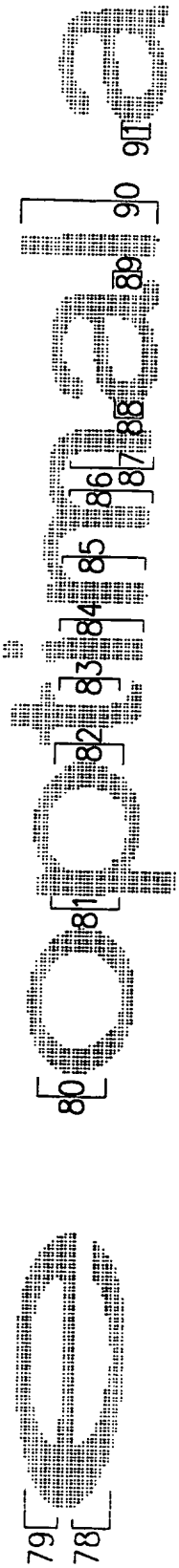

FIG. 7C
SECOND CONTINUATION

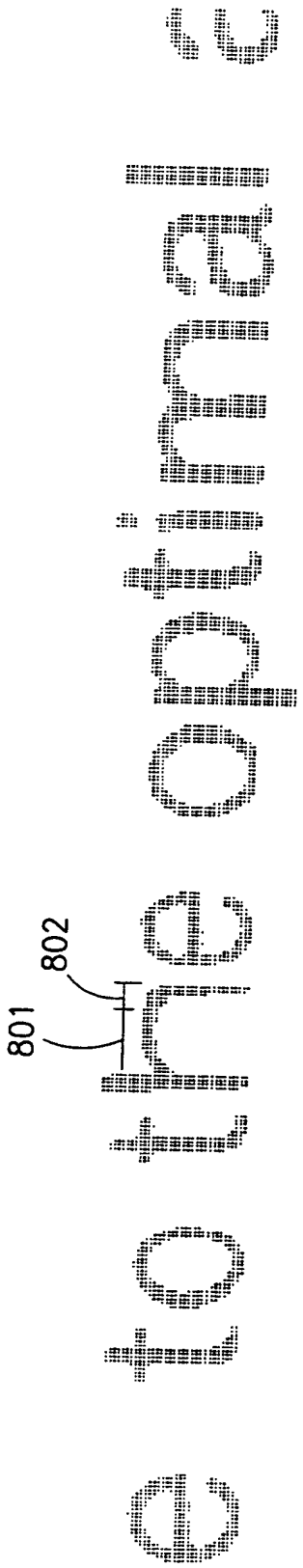

FIG.8

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IL 00/00010

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G06K9/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G06K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 279 655 A (SORICON CORP) 24 August 1988 (1988-08-24) page 9, line 5 - line 23	1
A	page 10, line 4 - line 14 page 20, line 15 - line 24	2-18
A	EP 0 680 005 A (IBM) 2 November 1995 (1995-11-02) abstract	2-18
A	US 5 581 633 A (HOTTA YOSHINOBU ET AL) 3 December 1996 (1996-12-03)	2-18

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
3 May 2000	11/05/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Sonius, M

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/IL 00/00010

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0279655 A	24-08-1988	AU 613013 B	25-07-1991
		AU 1191888 A	18-08-1988
		US 4897880 A	30-01-1990
EP 0680005 A	02-11-1995	NONE	
US 5581633 A	03-12-1996	JP 2933801 B	16-08-1999
		JP 6348896 A	22-12-1994
		KR 9616421 B	11-12-1996